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Validity of Self-Reported Solar UVR Exposure Compared to Objectively Measured UVR Exposure

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Abstract

Background—Reliance on verbal self-report of solar exposure in skin cancer prevention and epidemiologic studies may be problematic if self-report data are not valid due to systematic errors in recall, social desirability bias, or other reasons.

Methods—This study examines the validity of self-reports of exposure to ultraviolet radiation (UVR) compared to objectively measured exposure among children and adults in outdoor recreation settings in four regions of the United States. Objective UVR exposures of 515 participants were measured using polysulfone film badge UVR dosimeters on two days. The same subjects provided self-reported UVR exposure data on surveys and 4-day sun exposure diaries, for comparison to their objectively measured exposure.

Results—Dosimeter data showed that lifeguards had the greatest UVR exposure (24.5% of weekday ambient UVR), children the next highest exposures (10.3% ambient weekday UVR) and parents had the lowest (6.6% ambient weekday UVR). Similar patterns were observed in self-report data. Correlations between diary reports and dosimeter findings were fair to good and were highest for lifeguards (r = 0.38 – 0.57), followed by parents (r = 0.28 – 0.29) and children (r = 0.18 – 0.34). Correlations between survey and diary measures were moderate to good for lifeguards (r = 0.20 – 0.54) and children (r = 0.35 – 0.53).

Conclusions—This is the largest study of its kind to date, and supports the utility of self-report measures of solar UVR exposure.

Impact—Overall, self-reports of sun exposure produce valid measures of UVR exposure among parents, children, and lifeguards who work outdoors.

Keywords

skin cancer; sun exposure; UVR; dosimeters; validation; biomarkers

Background

Skin cancer is highly prevalent and is increasing (1), but it is also largely preventable. An estimated 90% of skin cancer can be prevented by using sunscreen properly, wearing

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protective hats and clothing, and reducing exposure to ultraviolet radiation (UVR) (2,3). UVR is the principal environmental cause of melanoma and non-melanoma skin cancers (4), so reduction of UVR exposure is an important aim of prevention programs.

Research to test strategies for prevention continues to be essential for reducing the burden of skin cancer (5), and improving the rigor of cancer prevention research methods is a priority (6). Most studies assessing UVR exposure rely on self-reports of habits, and there is no “gold standard” criterion for evaluation (6). While surveys are easy to administer, relatively inexpensive and non-invasive in large-scale population-based studies, recall and social desirability biases can limit their validity. Few studies using self-report of sun habits have used previously validated measures, or presented validity data for measures of UVR exposure (6).

Polysulfone film provides a non-invasive, portable and inexpensive method to objectively quantify levels of personal UVR exposure. Polysulfone (PS) film has been used in Australia and other countries as a UVR dosimeter since 1976 (7,8,9), and for personal dosimetry studies since about 1980. PS film can reliably measure solar UVR dose (10,11) and provides an opportunity to compare objective UVR exposure with self-reported measures. The availability of polysulfone dosimeters and a well developed methodology for analyzing them makes possible an assessment of the validity of self-report, though only a few studies to date have completed this type of analysis (12,13). A better analysis of the validity of self-reported UVR exposure will improve both etiologic and intervention research in cancer prevention and can advance both science and the public’s health.

Objective

This study had two main aims: 1) to describe the association between self-reported (survey and diary) and objective measures (polysulphone dosimeters) of UVR exposure, and 2) to identify any systematic error in subgroups by gender, latitude, study group (from an intervention trial), or skin cancer risk.

Materials and Methods

Overview

The data reported here are from the Sun Exposure and Protection Habits Measurement Study (SEPH), which was designed to test the validity of self-reports of sun exposure and sun protection practices by comparing them with objective physical and observational measures (13,14). SEPH is an ancillary study to a large trial of diffusion of a skin cancer prevention program in swimming pools (15). This study was an observational, multi-method descriptive correlational study with repeated measures, and was conducted in the summer of 2006. Data collection for each participant took place over a 4-day period that included two weekdays and two weekend days, and involved two days of both on-site and off-site data collection. Each person completed three self-report measures (baseline survey, 4-day diary, and final survey) and wore polysulfone dosimeters to measure personal UVR exposure for 2 days (one week day and one weekend day). The protocol was the same for each category of participant (lifeguards, parents and children 5 to 10 years). All procedures were approved by the Institutional Review Board (IRB) of Emory University.

Sample and Context

Sixteen pools in four metropolitan regions were selected from a larger sample of 245 pools (in 27 regions of the U.S.) already participating in the Pool Cool parent study (15). Regions were chosen based on a pre-established set of criteria, demonstrated level of interest, enthusiasm, and reliability in completing data collection tasks. In order to achieve representation from the two arms of the parent study and variation in ambient UV radiation based on geographic latitude, the four regions that were chosen were stratified based on study arm (Basic or Enhanced) and latitude (North or South, > 40 degrees north or < 35 degrees south). The metropolitan regions included were Austin, Texas and Phoenix, Arizona (south); and Omaha, Nebraska and Portland, Oregon (north).

The target sample to complete the study was 480 total participants, or 10 lifeguards and parent-child pairs from each of 16 pools. Thus, allowing for any unexpected obstacles and for dropout, each interested region needed to have at least six study pools to qualify for the SEPH Measurement Study. Also, each pool was required to have at least 15 lifeguards on staff, and at least 15 parent-child pairs with children 5–10 years of age currently taking swim lessons. Pools were also asked to provide a primary Pool Contact to assist with parent recruitment and overall coordination.

Recruitment and Data Collection Procedures

Participants were recruited at each pool on the day before the start of data collection (a Thursday or Friday). Each child had to be between the ages of 5–10 and be enrolled in swim lessons (or swim team) at the pool, and each child had to be accompanied by a parent or legal guardian who was willing to participate with their child. Parents were usually approached when they brought their children to the pool for swim lessons, and only one parent-child pair per family was eligible. Lifeguards were approached as they arrived at the pool for work, or during a break when they were not on duty or teaching swim lessons.

Study procedures were explained to potential participants, and those who agreed to participate were asked to sign consent forms and complete a baseline survey. Verbal assent was required for children. Participants were told that they would receive a $ 25 gift card for completing all components of the study. After completing the enrollment process, participants were given a Pool Cool sling bag as a thank-you gift for signing up and to keep the study materials together. All participants were asked to come to the pool for data collection in the morning on one weekday (either Thursday or Friday) and one weekend day (Saturday or Sunday). Reminders were sent to participants via phone, email, or text message, to make sure they would arrive at the pool in time to participate.

Participants completed the first Sun Habits Survey at the time of consent. On the first morning of data collection, they were given a Sun Habits Diary and asked to complete it each day during the study. Also on that morning, polysulphone (PS) badges in waterproof bracelets were placed on each participant’s right wrist by a research assistant. Each bracelet was attached as early in the day as possible when participants arrived at the pool and subjects were instructed to remove the PS badges in the afternoon after 4pm. On the third day (two days later), the application of polysulphone (PS) badges was repeated. Subjects were asked to complete a second Sun Habits survey and to return all study materials, including the diary, on the final day of the study.

Self-Report Measures: Sun Habits Survey and Diary

Self-reported sun exposure practices were assessed with both a survey and a 4-day diary. The survey included the main outcome measures used in the parent study (15), and is typical of large population intervention trial measures (6). The diary was used to include a more precise time-matched measure of sun exposure for comparison with the objective indicators.

The ***Sun Habits Survey*** was completed at enrollment and at the end of the study. Two versions of the survey were used: one for parents and children and one for lifeguards. Parents answered for both themselves and their children. Surveys included questions on sun-protection habits, sunscreen use, skin cancer risk factors, sunburn history, UV exposure, and demographics. Measures were selected or adapted from previously published studies and tools used in earlier studies conducted by the project team (16). Items on the surveys were identical to those used in the parent study (Pool Cool Diffusion Trial) (15), but the surveys were shortened to minimize respondent burden for the measurement study.

Demographic information that was gathered on the surveys included gender, age, race/ethnicity, job title (for lifeguards) and for lifeguards and parents, education, income level, marital status, and number of children. *Risk factor* questions including untanned skin color, hair color, eye color, sunburn history, tanning propensity, and history of skin cancer were used to categorize participants into low, moderate, or high risk groups. The brief set of risk factor items was based on previous studies (17) and adapted from the Brief Skin Cancer Risk Assessment Tool (BRAT) (18).

Usual solar UVR exposure was assessed by two questions asking the average number of hours (*1 or less, 2,3,4,5, or 6*) spent in the sun between 10 a.m. and 4 p.m. during the summer on *weekdays* and on *weekends*. A weekly average number of daily hours of sun exposure was computed by multiplying the weekday average by 5, the weekend average by 2, and dividing by 7. These survey questions were asked for lifeguards and children, but not for parents.

The ***Sun Habits Diary*** used in this study is a record of sun exposure and protective behavior and was simplified and adapted from a diary developed for earlier skin cancer prevention research (19). Participants were instructed to complete the diary for 4 consecutive days (including 2 weekend days), which is considered sufficient to estimate weekly sun exposure and sun protection (19). Parents were instructed to fill out separate diaries for themselves and their children (with or without input from the child, as available).

To report on their sun exposure, participants were asked to record whether they were outside for each hour of the day between 10 a.m. and 4 p.m. The amount of self-reported sun exposure was calculated by adding up all hours that each individual reported being outdoors for that day, resulting in a range from 0 to 6 hours. The daily sun exposure was added together and averaged across the 4 days of the diary to obtain measures of “usual sun exposure.” Another variable was created that examined sun exposure for the time period corresponding to putting on the PSD for each participant. If the participant reported removing the PSD before 4 pm, this was considered in that variable as well.

Objective Measures: Polysulfone Dosimeters

This study used 35 μm thickness PS film mounted in pre-glued white cardboard bracelet-style holders with a central aperture of 8 mm. For this study, a pre-exposure measurement of absorbance of the PS badges was made. The badges were stored in envelopes impervious to UVR until required. The PS badges, in the waterproof bracelets, were placed firmly on the participant’s right wrist by a research assistant, with the aperture on the back of the wrist so that the active area of the PS badges was clearly exposed. This is an appropriate anatomical position because it has been shown in previous studies to receive high levels of unprotected UV exposure (20). The application of dosimeters using bracelet-style holders has several advantages compared to applying them directly to clothing or to the skin: a) participants do not need to remove and reapply the PSDs if they change clothing; b) dosimeters placed within the bracelets are more protected if they become wet, thus minimizing the risk of loss or destruction; and c) this method is non-invasive (12).

Each bracelet was attached as early in the day as possible when participants arrived at the pool (between 9 am and noon) and the time was recorded. The subjects were instructed to remove the PS badges after 4 pm. At the completion of the exposures the PS badges were placed in sealed, light-proof envelopes, the time they were removed was recorded on the envelope, and the envelopes were returned to the research staff at their next visit to the pool.

Ambient solar UVR was measured using two PS badges placed on a horizontal surface out in the open each hour from 9am till 4pm each day at each pool. This enabled the researchers to accurately compute the percent of ambient UVR received by each individual at each participating swimming pool.

At the conclusion of all data collection, both personal and ambient PS dosimeters were sent for post-exposure measurement and analysis at the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). The PS badges were generally measured a week after exposure, in order to standardize readouts and minimize the dark reaction that PS film can undergo after UVR exposure to 10% or less. Analysis of the badges was completed with calibration using a solar UVR dose-response curve for PS film that was derived previously by ARPANSA. Calibrated and traceable measurements of the solar spectral ultraviolet irradiance incident on a horizontal surface using a double monochromator system were compared with simultaneous exposures of PS film on the foor of the ARPANSA laboratory in Melbourne (8,11,21). The dose response curve relates the change in absorbance induced by solar UVR against erythemally effective dose (EED) in $J.m^{-2}$ when weighted with the spectral erythemal response of the CIE (22).

Two indicators of objectively measured UVR exposure were computed from the laboratory results: estimated erythemal dose (EED) and percent ambient exposure. The EED was computed from the change in absorbance from pre-exposure to post-exposure and computed from the PS dose-response curve. The individual's percent ambient dose was computed by dividing the personal UVR dose by the ambient UVR measured at the pool site for the time the PS badge was worn. UVR exposure data from the dosimeters were entered into a relational database and analysed in conjunction with survey and diary data.

Some badges could not be analyzed because they were damaged in transmission from the participants to study staff or during preparation for laboratory analysis. This was most often due to the film and bracelet becoming too wet when worn in the swimming pool, or due to careless handling by subjects. Dosimeter loss of less than 10% is considered typical.

Statistical Analysis

Descriptive statistics, including 95% confidence intervals and inter-quartile ranges, were computed for all UV exposure variables by participant group and day of the week (weekday or weekend). The descriptive procedure in the complex samples module of SPSS (version 15.0) was used to obtain standard errors and 95% confidence intervals. The relationship between the objective measure of UV exposure (PS badge) and two self-report measures of UV exposure (4 day diary and survey) was assessed by taking the square root of the R^2 value obtained via the general linear model in the complex samples procedure of SPSS (version 15.0). Generally, UVR exposures of groups of subjects do not follow a normal distribution but that of a log-normal distribution (23). Thus, prior to conducting the GLM analyses, percent ambient was transformed using a logarithmic transformation. Based on this, both the mean and median were computed and reported since the median may be a better indicator of the exposure of a group.

The analytic approach described above was chosen to account for the non-zero intra-class correlation expected as a result of the clustering effect of participants nested within pool. Pearson correlation coefficients were computed separately for lifeguards, parents, and children, and within these groups for subgroups defined by gender, latitude, Pool Cool intervention arm, and skin cancer risk level. Differences in correlations between the three groups, lifeguards, parents, and children, as well as within the groups for subgroups defined by gender, latitude, Pool Cool intervention group, and skin cancer risk level were assessed based on Fisher's z transformation of r using standard z tests.

Results

Participation and Sample Characteristics

All parents and their children were enrolled in the study in pairs. 993 eligible participants were approached across the sixteen pools; 631 (64%) consented to participate in the study; and 564, or 89%, completed the study (201 parent-child pairs and 162 lifeguards). Most people who failed to complete the study did not show up for the second day of data collection. Participation and completion rates were similar across regions. For the analyses presented here, we excluded those cases with incomplete or outlying data ($z \geq 3.3$) for the dosimeter measure. Data from 149 (92%) lifeguards, 186 (93%) parents, and 180 (90%) children were included in the analyses. Those excluded did not differ significantly from those included in the analyses on the self-report measures of sun exposure or on demographic characteristics.

Most of the parent participants were female (95%), were the child's mother (92.5%) and reported being white (83.5%). In general, the parent participants were well-educated (65.5% college graduate or higher) and of moderate to high income (78.4% with > $ 50,000 household income per year). The mean age of the parent participants was 38.6 (SD=6.4) with a range of 25 to 67 years. Children had a mean age of 7.2 years (SD=1.7) and were nearly equally divided between boys (52.3%) and girls (47.7%). The lifeguard sample was 59.3% female with a mean age of 19.5 years (SD=5.8). They were mostly white (87.9%) and 28.7 % reported having not completed high school, 21.7% reported having completed high school, 42% reported completing some college with remainder reporting a 4-year college degree or higher.

Sun Exposure by Dosimeter, Diary and Survey Self-report

Descriptive statistics for the three measures of solar exposure are reported in Table 1. For all three measures of sun exposure, lifeguards were found to have higher levels of exposure on both weekdays and weekends than the children and parents. For the weekday measures (dosimeter, diary, and survey [no parent data]), lifeguards had significantly more exposure than both children and parents. For the weekend measures, lifeguards had significantly more exposure than the parents based on the dosimeter and diary measures. When compared to the children, lifeguards had significantly higher exposure on weekends based on the diary and survey meaures, but not on dosimeter-based exposure. In general, all three groups had significantly higher exposure on weekdays than on weekends when measured by diaries and dosimeters. Weekday and weekend exposure self-reports were not significantly different for lifeguards and children based on survey measures.

Association of Sun Exposure by Dosimeter and Self-report

Table 2 shows the correlation coefficients between the diary self-report measures of sun exposure and the dosimeter measures (serving as the criterion), for all three participant groups and sub-groups based on sex, latitude, study treatment group and skin cancer risk. For the combined groups, all correlations were statistically significant, and they were moderate to good for lifeguards ($r = .38$ for weekdays and $r=.57$ for weekends, $p<.01$ for both) and fair to good for the children and parents ($r=.18$ weekdays and $r=.34$ weekends for children, $p < .05$ and $p <.001$ respectively; $r=.29$ weekdays and $r=.28$ weekends for parents, $p < .01$). Figure 1 displays the mean exposure for each participant group and all three measures (except for parent survey data, which was unavailable). The figure shows that objectively measured and self-reported UVR data follow predictable patterns for each group and on weekdays and weekends.

Table 2 also shows findings regarding whether there was systematic error in the association between diary self-reports of UVR exposure and dosimeter-measured exposure in subgroups by gender, latitude, intervention study group, or skin cancer risk. Subgroup analyses revealed no significant differences in correlations for the lifeguards and parents and no significant differences between genders. However, correlations were significantly higher among children at moderate risk for skin cancer (r=.33 and .66) than for children at either low (r=.19 and .28) or high (r = .05 and .21) risk.

Association of Diary and Survey Self-Reports of Average Sun Exposure

Daily diary self-reports were used to assess criterion validity of self-report because they were most closely matched to times when participants wore the PS dosimeters. However, an important methodological question relates to the correlation between survey report of habitual sun exposure and the more detailed diary reports across two weekdays and two weekend days. As shown in Table 3, all associations were statistically significant and moderate to good. There was a tendency for the correlations to be higher between the second, or follow-up survey. The highest correlations overall were for average daily exposure computed by combining weekday and weekend reports from the survey and diary instruments (r=.27 and .54 for lifeguards and r=.45 and .53 for children, $p < .01$ for all). Correlations between survey and diary reports could not be computed for parents because the parents did not complete survey items about their solar exposure.

Discussion

The findings show that, overall, self-reports of sun exposure produce valid measures of UVR exposure among parents, children, and lifeguards who work outdoors. The highest rates of UVR exposure on both weekdays and weekends were found in the lifeguard group, who reported the longest time outdoors in survey and diary measures with high exposure also indicated the dosimeter readings. Compared to the lifeguards, adults and children were more likely to have intermittent exposure compared to the lifeguards who are more likely to have continuous exposure for longer periods.

The agreement between self-reported time outside by diary and the objective measurement of sun exposure by dosimeters are reasonably good, although they are better on weekends than weekdays. The improvement in self-report may be due to less variability in daily activities on weekends. The findings are consistent with previous recommendations that data should be collected over several days due to the variation in habits (12).

While parents and children reported similar amounts of sun exposure, the ambient measures from the dosimeters for parents were lower. The difference in sun exposure could be due to parents seeking shade more often while outdoors when children were more likely to be openly exposed while playing the swimming pool and deck areas. This might also explain the parents' appearing to over-report their UVR exposure on diaries (Figure 1); they may not have been outside for the entire hour marked as "outside" in their diaries. Also, since in most cases the parents were filling out the diaries for their children, they may not have perceived their own sun exposure to be the same when the children are receiving more. There may be a need to educate the parents to make them more aware of the difference in exposure.

Systematic error was minimal, and was found only for children who were at in the lowest or highest risk tertiles for skin cancer. The self-report measures of children at moderate risk were highly correlated with the dosimeter readings. These findings suggest that perhaps there should be more focus on educating higher-risk children and their parents on the importance of reducing exposure to UVR, as they may not be conscious of the risk.

The study is the largest of its kind to date. Previous studies of this issue have focused on mothers and children less than 12 months of age (12) and adults aged 40+ who were indoor workers (24). The associations found here were higher than those found by O'Riordan et al. (12) and slightly lower than those of Chodick, et al (24) – though the lifeguard associations were similar. Methodological differences between the studies may explain the differences in associations. In two publications from by Chodick and others (24,25), data were collected over a 7-day period, five weekdays and two weekend days, and the agreement on weekdays (between surveys/diaries and diaries/dosimeters) was significantly higher than weekends. Since the subjects in both studies were indoor workers and measures were taken during their work days, there was probably less variability during the five weekdays of data collection than the two weekdays in this study.

Some strengths of this study are the large sample, multiple locations, and a high cooperation rate. The study also includes two types of self-report which offered the possibility for more comparisons.

These findings are the third in a series of reports from the Sun Exposure Protection Habits (SEPH) study. Previous reports focused on the validity of self-reported sunscreen use compared with an objective test of the presence of sunscreen (14) and the validity of self-reported covering-up sun protection habits (use of hats, shirts and sunglasses) compared to observations (26). The results for sunscreen use showed good agreement between a swabbing method and diary and survey reports. Agreement between the objective measure of sunscreen use was greater for the diary than for the survey (14). The observations also had good agreement with the two self-report methods, surveys and diaries. There was fair to moderate agreement between the diaries and observation, which was better than the agreement between surveys and observation (26).

Data recorded in diaries and surveys were significantly correlated with dosimeter findings, despite surveys collecting information about usual rather than daily or hourly behavior. Surveys and diaries can be considered as reasonably valid options for assessing sun exposure habits, given the respondent and researcher burden and cost of using dosimeter badges in lieu of self-report. If diaries are used along with surveys to derive a combined assessment of UVR exposure, the validity is likely to be even better. Overall, surveys, which are common, inexpensive, and non-invasive, are an acceptable method of data collection. They are limited by the lack of time specificity, which is an advantage of diaries and polysulfone dosimeters. We recommend that researchers validate UVR exposure measures in a sub-sample with polysulfone film in studies using different methodology and new populations and that diary data should be collected across at least two weekdays and two weekend days. Also, as electronic UVR monitors allowing for real-time data collection become increasingly available (27), these tools should be incorporated in future studies. These devices would make it possible to measure not only cumulative UVR exposure but actual timing of the exposure, allowing for more fine-tuned assessments and comparisons with self-report.

The present report adds on a new focus on the validity of self-report measures of UVR exposure compared to exposure as assessed with PS dosimeters. This area of research is increasingly important now, as epidemiologic findings emerge showing the possible benefits of UVR exposure in decreasing risks of some cancers, prolonging survival and conferring other possible health benefits (28,29,30).

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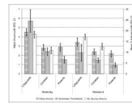

Figure 1. Mean exposure (error bar = 95 % CI) for participant groups by diary (hours), dosimeter (% ambient), and survey (hours)

Note: Two y axes are presented – hours for diary and survey on the left and % ambient on the right.

Table 1

Descriptive statistics for self-reported and measured sun exposure by participant group and day (weekday or weekend)

Method		Lifeguards (n=149)		Children (n=180)		Parents (n=186)	
		WD[1]	WE	WD	WE	WD	WE
BL Survey[2] (hours)	Mean (SE)	4.3 (.16)	4.0 (.13)	2.5 (.16)	2.9 (.15)	-	-
	95%CI	3.9, 4.6	3.7, 4.3	2.2. 2.9	2.6, 3.3	-	-
	Median	4.0	4.0	2.0	3.0	-	-
	IQR	3.0–6.0	3.0–5.0	2.0–3.0	2.0–4.0	-	-
Diary (hours)[3]	Mean (SE)	4.5 (.19)	3.4 (.20)	2.8 (.22)	2.4 (.14)	2.9 (.21)	2.2 (.14)
	95%CI	4.1, 4.9	3.0, 3.9	2.3, 3.2	2.1, 2.7	2.4, 3.3	1.8, 2.5
	Median	5.0	4.0	3.0	2.0	3.0	2.0
	IQR	3.0–6.0	2.0–6.0	2.0–4.0	1.0–3.0	2.0–4.0	1.0–3.0
Dosimeter (% Ambient)	Mean (SE)	24.5 (2.4)	9.8 (1.8)	10.3 (.85)	6.3 (.54)	6.6 (.73)	4.0 (.47)
	95%CI	19.3, 29.8	5.9, 13.7	8.5, 12.1	5.2, 7.5	5.0, 8.2	3.0, 5.1
	Median	22.2	6.2	7.9	4.1	4.7	2.3
	IQR	10.1–33.6	1.7–14.7	3.7–14.2	1.5–9.0	2.4–8.3	1.0–5.4

[1] WD=Weekday, WE=Weekend.

[2] Baseline survey

[3] Corresponding dosimeter day.

Table 2

Pearson correlation coefficients for percent ambient (dosimeter) and self-reported hours of exposure (corresponding diary day) for lifeguards, children, and parents

		Lifeguards			Children			Parents		
		n	Day 1 (WD)	Day 2 (WE)	n	Day 1 (WD)	Day 2 (WE)	n	Day 1 (WD)	Day 2 (WE)
	All	149	.38**	.57***	180	.18*	.34***	186	.29**	.28**
Sex	Male	60	.49**	.61***	91	.21*	.33**	10	-	-
	Female	89	.32**	.55***	83	.18	.35**	176	-	-
Latitude	North	75	.51**	.64***	92	.13	.34**	94	.32*	.42***
	South	74	.27*	.51***	88	.17**	.30**	92	.22**	.14
Intervention	Basic	76	.51***	.58***	88	.11	.40***	91	.20*	.38**
	Enhanced	73	.30**	.53***	92	.23*	.31*	95	.41**	.16
Skin Cancer Risk	Low	44	.36*	.41**	64	.19	.28*	61	.48**	.15
	Moderate	53	.43**	.62***	44	.33*	.66***	50	.24	.38**
	High	52	.37**	.61***	71	.05	.21	75	.20*	.36**

* p<.05,

** p<.01,

*** p<.001

-Not computed because 95% of parent sample was female.

Table 3

Pearson correlation coefficients for self-report measures of average exposure hours (survey and diary variables) for lifeguards and children

	WD Diary	WE Diary	Average Daily Exposure Diary
Lifeguards (n=149)			
BL survey[1]	.28**	.20**	.27**
FL survey	.47***	.53***	.54**
Children (n=180)			
BL survey	.35**	.35**	.45**
FL survey	.48***	.45***	.53***

[1] BL = baseline survey.

FL = follow-up survey

** $p<.01$,

*** $p<.001$